Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Report on Feasibility of Allowing Commercial Wireless Services to Use or Share Use of the 3.7-4.2 GHz Spectrum Band	)	GN Docket No. 18-122
	)	
Expanding Flexible Use of the 3.7 GHz to 4.2 GHz Band	)	GN Docket No. 17-183

COMMENTS OF ERICSSON

Ericsson hereby responds to the *Public Notice*[1] seeking input for an upcoming report by the Federal Communications Commission ("FCC" or "Commission") regarding the feasibility of allowing commercial wireless services to use or share use of the 3.7-4.2 GHz spectrum band, as directed by the MOBILE NOW Act.[2]

I. INTRODUCTION AND SUMMARY

Ericsson commends Congress for its focus on the 3.7-4.2 GHz band and the report it has directed the FCC to provide. Mid-band spectrum is an important element of the race to 5G, offering a balance of low-band capabilities (favorable signal range and indoor penetration) and

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[1] *Office of Engineering and Technology, International, and Wireless Telecommunications Bureaus Seek Comment for Report on the Feasibility of Allowing Commercial Wireless Services, Licensed or Unlicensed, to Use or Share Use of the Frequencies Between 3.7-4.2 GHz*, Public Notice, DA 18-446 (OET/IB/WTB rel. May 1, 2018) ("*Public Notice*").

[2] *See* Consolidated Appropriations Act, 2018, P.L. 115-141, Division P, the Repack Airwaves Yielding Better Access for Users of Modern Services (RAY BAUM'S) Act. Title VI of the RAY BAUM'S Act is the MOBILE NOW Act.

higher-band benefits (increased capacity).[3] This balance allows it to complement millimeter wave deployments in urban and suburban settings and extend the availability of 5G beyond densely populated areas.[4] Mid-band spectrum also enables the benefits of global harmonization, including early ecosystem availability. These and other factors make the 3.7-4.2 GHz band critical to the nation's 5G spectrum policy, and necessary if the United States is to be a leader in ongoing mid-band global spectrum harmonization effort.[5]

The report to Congress will address important questions on the feasibility of allowing new commercial wireless services to use the band or share it with existing services.[6] While the FCC should look at all possible solutions for how best to introduce new flexible-use services into new bands, a sharing approach in the 3.7-4.2 GHz band will be of limited utility. As discussed below, an Ericsson study confirms that significant separation distances for co-channel sharing between wireless broadband systems and earth stations will be needed (at least 30 kilometers under favorable conditions). While a further study indicates improved separation distance requirements for adjacent channel sharing, additional engineering solutions would be necessary to deploy in dense markets. Given the dispersed nature of existing operations in the band, database management tools do not adequately expand the opportunities for 3.7-4.2 GHz mobile

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[3] Comments of Ericsson at 2 (Oct. 2, 2017) ("Ericsson Comments").

[4] *Id*.

[5] *See* David Abecassis *et al*., *Global Race to 5G – Spectrum and Infrastructure Plans and Priorities*, ANALYSYS MASON, at 5 (Apr. 2018) (discussing "the importance of governments and regulators planning for sufficient spectrum release" to achieve 5G capabilities in "globally harmonized frequency ranges," including mid-band spectrum), https://api.ctia.org/wp-content/uploads/2018/04/Analysys-Mason-Global-Race-To-5G_2018.pdf; *see also id*. at 17-18 (providing examples of 5G mid-band spectrum assignments in various counties including, *e.g*., Japan (3.6-4.2 GHz), Italy and the U.K. (3.4-3.8 GHz), and Spain (3.6-3.8 GHz)).

[6] MOBILE NOW Act, § 605(b).

broadband spectrum. Finally, interference concerns raised by the Broadband Access Coalition ("BAC") proposal remain.[7]

There is, instead, much greater promise in repurposing the 3.7-4.2 GHz band for mobile broadband use. The record supports using some combination of band-clearing approaches, including relocating incumbents, using alternative transmission means such as fiber or Ku-band satellites and market-based approaches. Ericsson therefore commends Chairman Pai for announcing that the Commission will take up a *Notice of Proposed Rulemaking* ("*Notice*") in July.[8] As Chairman Pai recently observed, "I want the United States to be the best country for innovating and investing in 5G networks."[9]

Given the limited opportunities for large spectrum bandwidths in existing mid-band spectrum, C-band spectrum must be brought to market quickly in order for the U.S. to retain and expand its global leadership in wireless. Furthermore, it is important that progress towards 5G cellular networks take into account new requirements for enhanced mobile broadband, with adequate spectrum to allow operators to deploy channels, each with bandwidth on the order of 100 MHz.[10]

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[7] *See* Broadband Access Coalition Petition for Rulemaking, RM-11791 (June 21, 2017) ("BAC Petition").

[8] FCC Chairman Ajit Pai, Remarks at the Wireless Infrastructure Association Connectivity Expo, Charlotte, NC, at 4 (May 23, 2018), https://docs.fcc.gov/public/attachments/DOC-350919A1.pdf.

[9] FCC Chairman Ajit Pai, Remarks at the Mobile World Congress, Barcelona, Spain, at 1 (Feb. 26, 2018), https://apps.fcc.gov/edocs_public/attachmatch/DOC-349432A1.pdf.

[10] *See* Letter from Ericsson to FCC at 2-3 & Att. at 2 (Mar. 29, 2018) ("Ericsson March *Ex Parte*"); *see also* Comments of Qualcomm at 5 (Oct. 2, 2017) ("Qualcomm Comments") ("The FCC should auction flexible use licenses with wide channelization (*e.g.*, 100 MHz for increased performance by leveraging 5G's inherent ability to use wide channels) ….").

II. WHILE THE FCC SHOULD CONSIDER ALL SOLUTIONS TO INTRODUCE FLEXIBLE-USE SERVICES IN THE 3.7-4.2 GHz BAND, A SHARING APPROACH WILL BE OF LIMITED UTILITY

While the 3.7-4.2 GHz band is a prime candidate for mobile deployment – and the Commission should explore all opportunities to designate the band for flexible use – Ericsson is not optimistic that sharing among wireless broadband systems, Fixed Satellite Service ("FSS") C-band earth stations, and fixed microwave facilities is achievable or prudent in the 3.7-4.2 GHz band. A 2017 study performed by Ericsson (and submitted in the GN Docket 17-183 record) indicates the need for large separation distances that would make any co-channel sharing approach of limited utility.[11] Other data in the record from both terrestrial and satellite interests confirm that sharing spectrum in the band would be extremely challenging,[12] and that significant

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[11] *See* Ericsson, Co-Channel Sharing Assessment (Oct. 2017) ("Ericsson 3.7-4.2 GHz Co-Channel Sharing Assessment"), *appended as* Att. A to Ericsson Comments; *see also, e.g.*, International Telecommunication Union, Sharing Studies between IMT-Advanced Systems and Geostationary Satellite Networks in the Fixed-Satellite Service in the 3,400-4,200 and 4,500-4,800 MHz Frequency Bands, Rep. ITU-R M.2109, § 11, at 41-42 (2007) (minimum required separation distances for co-channel operations are "at least in the tens of kilometres," and minimum required separation distances for adjacent band operations are "up to tens of kilometres"), http://www.intelsat.com/wp-content/uploads/2017/10/ITU-SpectrumSharingStudy.pdf.

[12] Joint Reply Comments of Intelsat License LLC and Intel Corporation at 6 (Nov. 15, 2017) ("[M]aking spectrum in the 3700-4200 MHz band available on a co-frequency/co-coverage basis for flexible terrestrial use while protecting FSS incumbents will be extremely challenging."); Comments of Nokia at 10-13 (Oct. 2, 2017) at 10-13 ("Our preliminary study shows that the required exclusion zones around [fixed earth stations] could be a limiting factor for 5G deployments when 5G and FSS systems are deployed co-channel …."); Comments of the Satellite Industry Association at 34 (Oct. 2, 2017) ("SIA Comments") ("The ubiquity and sensitivity of C-band receive earth stations make sharing of the 3.7-4.2 GHz spectrum with additional terrestrial services extremely difficult.").

separation distances would be needed between terrestrial mobile base stations operating co-frequency with FSS C-Band earth stations.[13]

Specifically, Ericsson analyzed the potential for coexistence between terrestrial base stations and FSS space-to-earth receivers in the 3.7-4.2 GHz band. Its conclusions are applicable to the consideration of 5G air interfaces. Ericsson's analysis shows that the interference from terrestrial base stations is expected to be significantly higher than the interference thresholds at the satellite receiver. The analysis concluded that *at least 30 kilometers of separation* (best case scenario), and *potentially as high as 50-70 kilometers of separation* (less favorable conditions), would be needed between a terrestrial wireless base station and a C-band earth station in order for the two services to co-exist on the same spectrum.[14] Considering that most FSS receivers are located in urban/suburban locations, such large separation distances "eliminate possibilities for co-channel sharing in the populated areas."[15]

Ericsson also has continued to look at sharing in the 3.7-4.2 GHz band and is currently conducting a study of adjacent channel sharing. While early projections suggested that the separation distance requirements for adjacent channel sharing may be less than with co-channel

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[13] *See* SES Americom, Inc., Technical Annex, at 1 (Mar. 2018), *appended to* Letter from SES Americom to FCC (Mar. 2, 2018) ("SES Letter"); Nokia, Mid-Band NOI Technical Inputs, at 20 (Jan. 18, 2018), *appended to* Letter from Nokia to FCC (Jan. 22, 2018); *see also* SES Letter at 2 (noting that the necessary separation distances "would make deployment of terrestrial mobile services impossible in significant portions of the country," and that co-channel sharing "would create a lose-lose situation for the satellite community and prospective terrestrial service providers").

[14] Ericsson 3.7-4.2 GHz Co-Channel Sharing Assessment at 1, 3.

[15] *Id*. at 3.

sharing,[16] a more recent assessment indicates that separation distance requirements for adjacent channel sharing alone will not be enough to support wide scale deployment of 5G systems because – as shown in the attachment – the majority of FSS earth stations are located in urban/suburban areas.[17] If, for example, relocation of an incumbent were not possible in the interim, the adjacent channel study concludes that some co-existence between International Mobile Telecommunications ("IMT") and FSS receivers would be possible through band segmentation provided that mitigation techniques are deployed. Physical separation of IMT base stations from FSS receiver locations of a few kilometers would be an important element for the successful deployment of mobile broadband in the band, along with other steps such as front-end filtering for earth stations. This is especially true for the majority of FSS receivers that are located in urban and suburban areas.

Further, database management approaches are not advisable for the 3.7-4.2 GHz spectrum. Database management approaches work best when there is sparse use of the spectrum by competing services. The mobile industry has an interest in global access to large parts of the mid-band ranging from 3.4-4.2 GHz, and the 3.7-4.2 GHz band is ideal for compatibility with industry directions for 5G – even if it is not completely harmonized with other ITU-R regions. The Citizens Broadband Radio Service ("CBRS") shared spectrum model in the 3.5 GHz band, for example, uses a three-tiered system for small cell deployments with only 70 megahertz available for licensed use under the assumption of dynamic spectrum allocation. The CBRS

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[16] *See* Ericsson Comments at 8; Ericsson, Expanding Flexible Use in Mid-Band Spectrum between 3.7 and 24 GHz, at 10-11 (Oct. 29, 2018), *appended* to Letter from Ericsson to FCC (Jan. 30, 2018) ("Ericsson January *Ex Parte*").

[17] *See* Ericsson, Adjacent Channel Sharing Assessment (May 2018), *appended as* Att. A hereto.

model is particularly unsuited to the 3.7-4.2 GHz band, which is expected to be a foundational band for 5G.[18] A dynamic approach to spectrum assignment, as used by the Spectrum Access System ("SAS") in the CBRS band, offers significant disadvantages in exacting the right kind of value in the 3.7-4.2 GHz band for the Commission. Moreover, it places a level of uncertainty with regard to interference tolerance needed in dense deployment environments, for adjacent channel use cases. Indeed, given the required separation distances, the record shows that "a database attempting to determine whether to authorize a terrestrial wireless transmission in the 3.7-4.2 GHz band would need to consider the impact on hundreds or even thousands of C-band receive earth station antennas in the surrounding area," and that the computing power needed to make each determination "would be staggering."[19] Attempting to make these decisions quickly, in coordination with multiple database administrators, "would be more challenging still."[20]

Lastly, Ericsson does not support the BAC proposal to introduce fixed point-to-multipoint ("P2MP") terrestrial services into the band prior to any flexible-use services.[21] The BAC seeks to allow immediate P2MP access to the entire 3.7-4.2 GHz band, coordinated under FCC Rule Part 101, and has argued that its proposal can protect existing satellite operations and accommodate future satellite changes.[22] Sharing concerns remain, however. As SES and

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[18] *See* Ericsson Comments at 6-7; *see also* SIA Comments at 40 (Oct. 2, 2017).

[19] SIA Comments at 41.

[20] *Id*.

[21] *See* BAC Petition, *supra*.

[22] *See generally id*.

Intelsat have explained, they "do not believe that BAC can remedy interference quickly enough to satisfy the high reliability requirements of [satellite] video customers."[23]

III. THERE IS MUCH PROMISE IN REPURPOSING THE 3.7-4.2 GHz BAND FOR MOBILE BROADBAND, AND THE RECORD SUPPORTS A COMBINATION OF BAND-CLEARING APPROACHES

Despite the findings above, there is much promise in repurposing the 3.7-4.2 GHz band for mobile broadband use. The record supports a variety of options for clearing the band, and the Commission should consider all of them. Options include an FCC-led process or a market-based model in which the incumbents agree to surrender spectrum rights for payment from new entrants.[24] In either event, incumbent FSS C-band operations could be repacked to a smaller portion of the band, relocated to other spectrum (*e.g.*, the Ku-band), transitioned to another transmission platform (*e.g.*, fiber or fixed service), or moved to more remote areas subject to interference protection from new entrants (with fiber or other technologies for backhaul).[25]

Ericsson recognizes the need for a viable transition plan for repurposing the band for mobile services. As discussed above, Ericsson has conducted studies to examine the potential for co-channel and adjacent-channel coexistence. While the conclusion of the adjacent channel study supports band segmentation as a possible interim solution, there are a number of limitations that would impact its usefulness – and the percentage of FSS earth stations located in urban/suburban areas is a primary concern. It may be necessary to consider other approaches,

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[23] Letter from Intelsat, SES, and Intel to FCC at 2 (Apr. 20, 2018).

[24] *See, e.g.*, Ericsson Comments at 7; Comments of CTIA at 3-5 (Oct. 2, 2017) ("CTIA Comments"); Comments of the Telecommunications Industry Association at 4 (Oct. 2, 2017); Comments of Verizon at 17 (Oct. 2, 2017) ("Verizon Comments").

[25] *See, e.g.*, Ericsson Comments at 7; CTIA Comments at 5-6, 10-12; Qualcomm Comments at 5; Verizon Comments at 17-19.

especially those that can facilitate early deployment of 5G in this band. For instance, all or a portion of the band that can support 5G services – such as indoor locations that are sufficiently isolated from satellite earth stations – could be made available over a short interim period allowing the transition process to take place. In our view, something on the order of 100 MHz will be needed on a per-operator basis to fulfill mobile 5G broadband use cases, and therefore Ericsson would like to see the entire C-band cleared for licensed mobile use. An investment climate conducive to the deployment of 5G services requires assurance that enough spectrum will be cleared by a certain time.

IV. CONCLUSION

Ericsson urges the Commission to promptly launch a *Notice* consistent with the positions discussed above and set forth in Ericsson's responses to the Commission's *Notice of Inquiry* in GN Docket No. 17-183.[26]

Respectfully submitted,

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[26] *See generally* Ericsson Comments; Ericsson January *Ex Parte*; Ericsson March *Ex Parte*.

Attachment A

Adjacent Channel Sharing Assessment

A previous Ericsson study indicated that co-channel sharing between IMT transmitters and FSS space-to-earth receivers was not feasible in the 3.7-4.2 GHz band. [1] Ericsson has since updated its analysis of interference to satellite systems from adjacent band IMT-2020 emissions.

FSS earth stations operate in a variety of environments with urban settings accounting for approximately 47% of the total earth stations deployed in the US markets and suburban settings accounting for 18%. If sharing the band, terrestrial mobile systems would be expected to operate in proximity to FSS earth stations in the 3.7-4.2 GHz band. Consequently, this analysis primarily considers urban scenarios as those represent a majority.

Some information pertaining to satellite receivers is available in Recommendations ITU-R S.465 and ITU-R S.2368-0. Information regarding IMT transceiver characteristics appears in 3GPP TS 38.104 and 3GPP TS 38.101 for base stations (BS) and mobile stations (MS), respectively. We have used simulation parameters in accordance with the docket. 5G air interfaces, specifically modeled on NR with adaptive beamforming, are assumed at the base station.

We have determined that the interference from IMT-2020 BS towards satellite systems is expected to meet the interference thresholds (i.e. Interference-to-noise ratio) at the satellite receiver with such mitigation techniques as separation distances, lower transmit power in adjacent frequencies or in some cases guard bands. Furthermore, the analysis indicates that the IMT UE will meet the interference threshold at the modeled satellite receiver for all scenarios with mere application of maximum power reduction, possibly in conjunction with power control in a spatially relevant manner.

Satellite System Aspects

The satellite-to-earth link (*i.e.*, downlink) is represented by an earth station that receives satellite transmissions from a geostationary orbit. FSS earth stations are modeled with a dish antenna of a certain diameter and elevation angle that depends on latitude, and the orientation of the satellite's parking slot in geostationary orbit. We consider urban areas as the worst case for coexistence with FSS, due to the wide variety of deployment heights of IMT base stations. In urban areas, smaller satellite dish antennas with high elevation angle are likely to be installed

[1] *See* Ericsson, Co-Channel Sharing Assessment (Oct. 2017), *appended as* Att. A to Comments of Ericsson (Oct. 2, 2017) (confirming that significant separation distances for co-channel sharing between wireless broadband systems and earth stations would be needed (at least 30 kilometers under favorable conditions)).

on rooftops; whereas in suburban or rural areas, larger dish antennas with a low elevation angle are typically mounted close to ground level. Ericsson's analysis originally looked at elevation angles between 5 and 40 degrees and dish antennas with diameters of 2.4 and 9 meters. However, based on configurations noted in the record[2] it appears that an elevation angle of 40 degrees can be taken as a representative value. The antenna reference pattern is based on Recommendation ITU-R S.465.

FSS Receiver	
Earth station deployment	Urban
Channel Bandwidth (MHz)	36
Tx power (W)	251.2
Antenna Gain (dBi)	38
Antenna diameters[3] (m)	2.4
Antenna pattern	ITU-R Recommendation S.465
Receiver system noise temperature (K)	100
Above ground level (m)	30 (practically no Clutter losses)
Elevation angles (degrees)	40
Filter characteristics	ACS of 45 dB[4]
Blocking level	-55dBm[5]

Table 1. FSS Characteristics

[2] SES Americom, Inc., Technical Annex (Mar. 2018), *appended to* Letter from SES Americom to FCC (Mar. 2, 2018), https://ecfsapi.fcc.gov/file/103022645119974/SES%20Ex%20Parte%20on%20FSS%20IMT%20Co-Frequency%20Sharing%202%20March%202018.pdf.

[3] FSS antennas in this band may be deployed in a variety of environments. Smaller antennas (1.8-3.8 meters) are commonly deployed on rooftops, whereas larger antennas are typically mounted on the ground and deployed in semi-urban or rural locations. 5° is considered as the minimum operational elevation angle.

[4] Simulations were performed using a combined number for IMT transmitter OOB and earth stations receiver ACS. We assumed that earth stations would be able to improve their blocking capability corresponding to an ACS of 45dB.

[5] Intelsat & SES, FCC Debrief on C-Band / 5G Coexistence (Apr. 19, 2018) ("Intelsat & SES FCC Debrief"), https://ecfsapi.fcc.gov/file/104231624822057/Intelsat%20SES%204-23%20Ex%20Parte%20Attachment%20C%20C-band_5G_Deck.pdf.

Terrestrial Mobile Aspects

The IMT system considered has base stations with beamforming antennas which dynamically steer their beams toward UEs while adaptively controlling EIRP. Antennas have a mechanical downtilt of 10 degrees for the macro urban scenarios. The maximum antenna gain is 23dBi. BS unwanted emissions characteristics are described in 3GPP TS 38.104.

IMT Transmitter	
Base station deployment	Macro Urban
Antenna height (m)	20
Antenna Downtilt (degree)	10
Antenna Characteristics	BS Beamforming Antenna Array of 8x8 with 0.6λh, 0.9λv Maximum element gain of 5dBi Maximum antenna gain of 23dBi 64 dual-polarized elements with half power beamwidth of 65 degrees for each element. No UE Beamforming
Losses (dB)	Polarization loss: 0dB Antenna ohmic loss: 4dB Body loss: 4dB (For UE only) UE: NF of 9dB BS: NF of 5dB
Maximum base station output power	UE: 0.25W or 23dBm BS: 8W or 39dBm, 4W or 36dBm
Channel Bandwidth	100 MHz
BS Emission Masks	ACLR: 45dB TS 38.104 Clause 6.6.4.2.1/6.6.4.2.3 Tables for Category A BS
UE Emission Masks	ACLR: 30 dB TS 38 101, clause 6.6.5.1 and 6.6.5.2

Table 2. IMT Characteristics

Coexistence Scenario

The propagation model follows ITU-R P.452-16.[6] A flat-earth terrain model is assumed. Clutter losses at the transmitter and receiver side were also considered as per ITU-R P.2108. For the analysis, the long-term interference criterion compared separation distances assuming *I*/*N* = –10 dB. This value was selected based on assumptions by previous ITU studies and other studies by the satellite industry.[7]

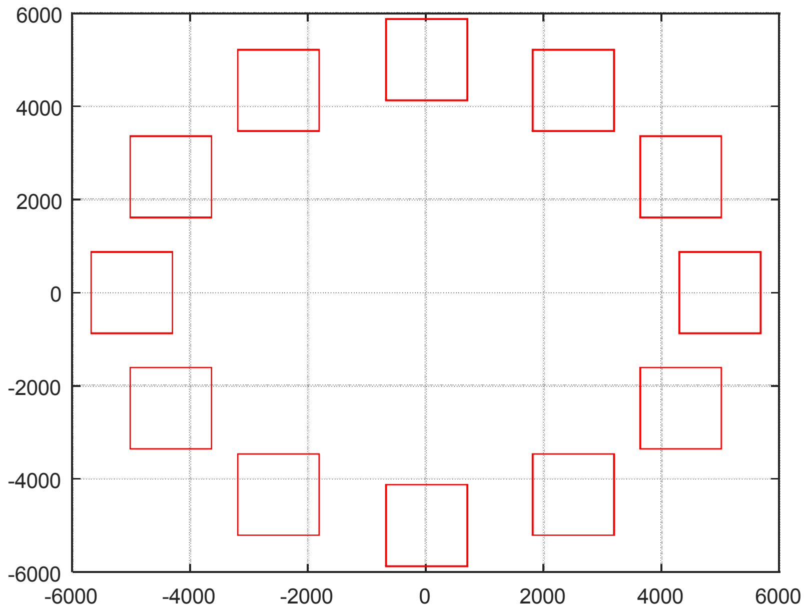

Figure 1. Cluster model layout (coordinates in meters)

We model the aggregate interference from a 5G network consisting of multiple clusters of IMT base station sites, each with an area of 1000x1000m representing isolated geographic zones where IMT macro base stations and associated user equipment are deployed in a Manhattan-like map. The set of clusters surround a single FSS earth station receiver centered at coordinates (0 m,0 m) as shown in the Figure 1. Macro base stations are located outdoors and UEs are 95% outdoor and 5% indoors. Transmission is based on TDD, with a ratio between Downlink and Uplink of 80:20. Traffic loading is set at 50%. A single cluster is illustrated in the network map of Figure 2. Interference at the FSS receiver is based on the aggregate

[6] Propagation executed in area mode with the percentage of time for which the particular values of basic transmission loss are not exceeded equal to 50%. Flat earth is assumed for the modeling, which is valid roughly to 50 km link distance.

[7] Intelsat & SES FCC Debrief, *supra*.

interference from all clusters. Our analysis properly considers the effects of both Out-of-Band Emissions (OOBE) and blocking.

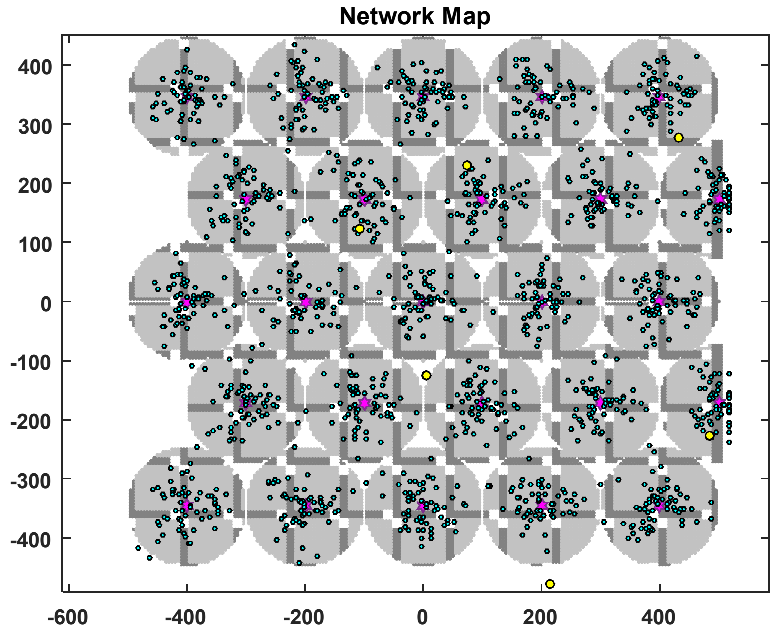

Figure 2. Network Map in a Cluster (coordinates in meters)

Blocking

With an earth stations receiver LNB operational limit of -85 dBW (-55 dBm) and wide-area IMT base stations operating with a transmit power of 39dBm/100MHz in total band of 400MHz within the 3.7-4.1 GHz range, we have determined that an additional 27 dB attenuation is needed to avoid limitations due to LNB blocking with the FSS elevation angle at its minimum operational value of 5 degrees. When more realistic values for FSS elevation angles (such as 40 degrees) are instantiated, the required additional attenuation to avoid LNB blocking is less than 10dB for a minimum separation distance of 1km. Increasing the minimum separation distance to 5km or reducing the base station transmit power by 3dB could eliminate blocking issues at the LNB.

	IMT interference in 400MHz (dBW/400MHz)	Total interference IMT+FSS[8] (dBW)
40dg/1km BS Tx power of 39dBm	-77.9794	-77.9622
40dg/5km BS Tx power of 39dBm	-91.9794	-92.4667
40dg/1km BS Tx power of 36dBm	-80.68	-80.65
40dg/5km BS Tx power of 36dBm	-93.88	-93.25

Table 3. Received Interference at the Earth Station Receiver LNB

Coexistence Results

Three options to improve adjacent channel sharing were investigated: coordination zones, guard bands, and reduction of transmit power levels when operating near FSS receivers.

- Increase of separation distances from 1km to 5 km reduces interference to FSS earth station by ~17 dB.
- Considering a separation distance of 5 km and 5 MHz guard band reduces interference to the FSS earth station down to I/N of -8 dB, again with an FSS antenna elevation angle of 40 degrees.
- When the transmit power is reduced to 36 dBm, with a separation distance of 5 km, an I/N of -13.8dB is achieved.
- Lastly, with the assumption of flat spurious level, an introduction of a guard band wider than 5 MHz does not improve interference reduction at the FSS earth station.

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[8] FSS self-interference is assumed to be -72dBm, according to the Intelsat & SES FCC Debrief, *supra*.

Conclusion

We conclude our study of adjacent channel co-existence between IMT-Advanced macro-cell base stations and FSS space-to-earth receivers in the 3.7-4.2 GHz band with the following conclusions:

› In areas where relocation of the incumbent is not possible in the interim, mitigation techniques will be needed for adjacent channel co-existence between IMT and FSS. Coordination zones between IMT base stations and FSS receiver locations will be an important consideration in the successful deployment of mobile broadband in the band. The sizes of such zones could vary between 1 to 5 kilometers radius, depending on the specific IMT and FSS deployment characteristics. This is especially true for the majority of FSS receivers that are located in urban and suburban areas.

› Aggregate interference from UEs leads to an I/N of well below -10 dB even for the worst case and does not present problems for any of the scenarios studied.

› It will be necessary for FSS earth station operators, operating in close vicinity to IMT, to install front-end filters before the LNB to minimize the impact on receiver performance.

› For the worst case blocking scenarios (viz. low elevation angles for FSS and 1 km separation distance between IMT base stations and the earth station), an additional attenuation of ~27 dB at the earth station receiver LNB is needed. For cases with higher elevation angle and larger minimum separation distances or lower Base station transmit power, additional attenuation in the LNB might not be necessary.